

## REMARKS

Claims 1-13 and 17 are pending. By this Amendment, Claims 14-16 are canceled without prejudice or disclaimer, the Specification and Claims 1 and 4-13 have been amended, and dependent Claim 17 added. Applicants respectfully submit no new matter is presented herein.

### Drawings

The drawings are objected to because only that which is old is illustrated in Figure 15. Enclosed herein is a Replacement Sheet of formal drawing Figure 15, which has been amended herein to include a -- Related Art -- legend. As such, Applicants respectfully request withdrawal of the objection.

The drawings are objected to under 37 C.F.R. §1.84(p)(5) because they do not include particular reference numbers (that is, 9 and 10) mentioned in the description. Applicants have amended the specification to correct typographical errors therein and which are believed to render the objection moot. Applicants respectfully request withdrawal of the objection.

The drawings are objected to under 37 C.F.R. §1.83(a) because they do not show the features described in the specification. Enclosed herein is a Replacement Sheet of formal drawing Figure 1(f), which is believed to be amended in a manner responsive to the objection. Applicants respectfully request withdrawal of the objection.

### **Specification**

The Title of the application is objected to as it is considered not to be descriptive of the invention to which the claims are directed. Applicants have amended the Title herein in a manner believed to be responsive to the objection. Applicants respectfully request withdrawal of the objection.

The Abstract is objected to for informalities therein. Enclosed herein is a Substitute Abstract, along with a marked up version of the originally filed Abstract indicating the location of the changes made thereto by the Substitute Abstract, which is believed to address the informalities in the originally filed Abstract. Applicants respectfully request withdrawal of the objection.

The Specification is objected to for informalities therein regarding the lack of any description of Figures 1(a) through 1(f) and 9(a) through 9(f). The Specification is amended in a manner believed to be responsive to the objection. Applicants respectfully request withdrawal of the objection.

### **Claim Rejections – 35 U.S.C. §112**

Claims 1-16 are rejected under 35 U.S.C. §112, second paragraph. Applicants have amended the claims in a manner believed to be responsive to the rejection. Applicants respectfully request withdrawal of the rejection.

### **Claim Rejections – 35 U.S.C. §101**

Claims 15-16 are rejected under 35 U.S.C. §101. As Claims 15-16 have been canceled herein without prejudice or disclaimer, Applicants respectfully submit the rejection is rendered moot and should be withdrawn.

**Claim Rejections – 35 U.S.C. §103**

Claims 1-3 and 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Applicant's Admission of Prior Art (AAPA) in view of U. S. Patent No. 3,956,014 to Landsman et al. (Landsman). Applicants respectfully traverse the rejection.

Claim 1 recites a method for producing a membrane-electrode structure, comprising the steps of applying a catalyst paste onto a sheet substrate, wherein the catalyst paste comprises an electron conducting material supporting a catalyst and an ion conducting material; drying the catalyst paste to form an electrode catalyst layer; thermally transferring said electrode catalyst layer onto each side of a polymer electrolyte membrane to form a laminated body, wherein said electrode catalyst layer is connected to each side of said polymer electrolyte membrane; applying a first slurry onto a carbon substrate layer, wherein the first slurry comprises a water-repellent material and an electron conducting material; drying the first slurry to form a water-repellent layer; ***applying a second slurry onto said water repellent layer, wherein the second slurry comprises an electron conducting material and an ion conducting material; drying the second slurry to form a hydrophilic layer, wherein a diffusion electrode consisting of said carbon substrate, said water-repellent layer and said hydrophilic layer is formed; positioning said diffusion electrode on said electrode catalyst layer of said laminated body via said hydrophilic layer; and pressing said laminated body and said diffusion electrode together***

*under heating to integrate said laminated body and said diffusion electrode.*

The object of the invention disclosed in Landsman appears to be to provide an electrochemical cell electrode structure having clearly defined hydrophobic and hydrophilic passages for elimination of water generated and the diffusion of gas.

Specifically, Landsman teaches the electrode is formed by depositing successive layers of hydrophobic material (12) and hydrophilic catalyst-containing material (13) one upon the other until a layered structure having a predetermined thickness is obtained, and slicing the layered structure perpendicular to the layers into a thin sheet, and then arranged on the supporting substrate (10). Thus, the surface of the sliced thin sheet, which will be connected to the supporting substrate (10), includes both the hydrophobic material (12) and the hydrophilic catalyst-containing material (13) in a window pane pattern (see Landsman, column 3, line 44 – column 4, line 20, Figs. 5-6).

In the present invention, the membrane-electrode structure is formed by constituting a diffusion electrode such that the water-repellent layer is placed on the carbon paper and that the hydrophilic layer is further placed on the water-repellent layer. Then, the resulting diffusion electrode is laminated on an electrode catalyst layer through the hydrophilic layer. See Fig. 1(f) for an exemplary embodiment. As a result, a membrane-electrode structure in which the diffusion electrode is connected to the electrode catalyst layer through the

hydrophilic layer is obtained (see the originally filed application, at page 23, lines 4-20 as well as Fig. 1(f)).

According to the invention recited by the Claim 1, the method for producing a membrane-electrode structure comprises the steps of forming a hydrophilic layer on a water-repellent layer and then positioning the diffusion electrode on the electrode catalyst layer of the laminated body *via* (or using) ***the hydrophilic layer***, and pressing the laminated body and the diffusion electrode together under heat to integrate the laminated body and the diffusion electrode. As a result, the claimed invention provides or results in a membrane-electrode structure having excellent adhesion between the electrode catalyst layer and diffusion electrode, and a polymer electrolyte fuel cell using such a membrane-electrode structure.

The AAPA teaches a membrane electrode structure (10) incorporated in a polymer electrolyte fuel cell that has a pair of electrolyte catalyst layers (3, 3) and diffusion electrodes (5, 5) laminated onto the electrode catalyst layers (3, 3). Each diffusion electrode (5) is configured to form a porous water-repellent layer (7) on a carbon substrate layer (6) for the diffusion of gas.

The Office Action correctly notes that the electrolyte catalyst layer (3) of the AAPA is hydrophilic. However, the claimed invention recites that the diffusion electrode includes a hydrophilic layer and not the electrode catalyst layer.

Moreover, the claimed invention recites the hydrophilic layer is formed on the diffusion electrode and not the electrode catalyst layer. While the electrolyte catalyst layer (3) of the AAPA may have hydrophilic characteristics or traits, the

AAPA does teach or suggest the diffusion electrode (5) having a hydrophilic layer formed therein.

As such, the Applicants respectfully submit that the AAPA does not provide or otherwise obtain the desired adhesion between the electrolyte catalyst layer (3) and the diffusion electrode (5).

Applicants note Claim 1 is a method claim and not an apparatus claim, so the inventive concepts are presented in the recited steps of the claim and not the resulting structure (which would be critical if the claim were a product-by-process claim).

Also, nowhere in the AAPA or the portions of the originally filed application discussing same, is there any mention of a step wherein the diffusion electrode is formed to have a hydrophilic layer. As such, the AAPA does not teach or suggest the step of forming a diffusion electrode to have a hydrophilic layer that is used to position the diffusion electrode on the electrode catalyst layer.

In particular, the AAPA does not teach or suggest applying a second slurry onto a water repellent layer, wherein the second slurry includes an electron conducting material and an ion conducting material, wherein the second slurry is then dried to form a hydrophilic layer. Applicants note the claimed invention recites such steps in the formation of a diffusion electrode having, among other features, a hydrophilic layer. Applicants further contend that the AAPA fails to teach or suggest such recited steps.

Landsman is cited for supposedly curing the above-noted deficiency of the AAPA, yet nowhere does the Office Action identify any portion of Landsman for

teaching or suggesting a step or steps wherein a second slurry is applied onto a water repellent layer, wherein the second slurry includes an electron conducting material and an ion conducting material, and then the step of where the second slurry is then dried to form a hydrophilic layer.

Furthermore, because Landsman does not teach or suggest the membrane-electrode structure, it would have been difficult for a person skilled in the art to arrive at the presently claimed invention without conducting undue experimentation even if the membrane electrode structure of the APAA is combined with the teachings of Landsman.

To establish *prima facie* obviousness, each and every feature of a rejected claim must be taught or at least suggested by the applied art of record. See M.P.E.P. §2143.03.

As explained above, the AAPA and Landsman, alone or in any combination thereof, teach or suggest a step or steps wherein a second slurry is applied onto a water repellent layer, wherein the second slurry includes an electron conducting material and an ion conducting material, and then the step of where the second slurry is then dried to form a hydrophilic layer. Such features, among others, are recited by Claim 1. Therefore, Applicants respectfully submit that Claim 1 is not rendered obvious in view of the AAPA and Landsman and should therefore be deemed allowable.

Claims 2-13 and 17 depend, directly or indirectly, from Claim 1. It is respectfully submitted that these claims are allowable over the AAPA and

Landsman at least for the same reasons Claim 1 is allowable, as well as for the additional subject matter recited therein.

Applicants respectfully request withdrawal of the rejection.

Claims 1-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over the AAPA in view of U.S. Patent No. 4,104,197 to Heffler. Applicants respectfully traverse the rejection.

Claim 1 is discussed above.

The AAPA and deficiencies therein are discussed above.

Applicants respectfully submit that Heffler, like Landsman, fails to teach or suggest forming a hydrophilic layer on a water-repellant layer. Accordingly, Heffler does not teach or suggest a hydrophobic layer being placed in a diffusion electrode layer. Hence, in Heffler, problems stemming from this feature do not exist and there is no need to solve the problem by reducing contact resistance between the hydrophobic layer and the diffusion electrode layer.

Thus, Applicants respectfully submit that one of ordinary skill in the art would not be motivated to combine or otherwise modify the AAPA based on teachings of Heffler in a manner asserted by the Office Action as it would be extremely difficult, if not unlikely, for such a person skilled in the art to arrive at the membrane electrode structure in which a diffusion electrode is connected to an electrode catalyst layer through a hydrophilic layer.

Accordingly, it cannot be said that the present invention would have been obvious to a person skilled in the art even if the membrane electrode structure of APAA is combined with the teachings of Heffler.

To establish *prima facie* obviousness, each and every feature of a rejected claim must be taught or at least suggested by the applied art of record. See M.P.E.P. §2143.03.

As explained above, the AAPA and Heffler, alone or in any combination thereof, teach or suggest a step or steps wherein a second slurry is applied onto a water repellent layer, wherein the second slurry includes an electron conducting material and an ion conducting material, and then the step of where the second slurry is then dried to form a hydrophilic layer. Such features, among others, are recited by Claim 1. Therefore, Applicants respectfully submit that Claim 1 is not rendered obvious in view of the AAPA and Heffler and should therefore be deemed allowable.

Claims 2-13 and 17 depend, directly or indirectly, from Claim 1. It is respectfully submitted that these claims are allowable over the AAPA and Heffler at least for the same reasons Claim 1 is allowable, as well as for the additional subject matter recited therein.

Applicants respectfully request withdrawal of the rejection.

Claims 1-3 and 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over the AAPA in view of U. S. Patent No. 4,568,442 to Goldsmith. Applicants respectfully traverse the rejection.

Claim 1 is discussed above.

The AAPA and deficiencies therein are discussed above.

Applicants respectfully submit that Goldsmith, like Heffler and Landsman, fails to teach or suggest forming a hydrophilic layer on a water-repellant layer in a

manner using the steps recited by Claim 1. Applicants note the hydrophilic layer taught by Goldsmith is precipitated on a particulate material and is not formed in a manner using the process steps recited by Claim 1.

Applicants respectfully submit that Goldsmith, like Heffler and Landsman, fails to teach or suggest forming a hydrophilic layer on a water-repellant layer. Accordingly, Goldsmith does not teach or suggest a hydrophobic layer being placed in a diffusion electrode layer. Hence, in Goldsmith, problems stemming from this feature do not exist and there is no need to solve the problem by reducing contact resistance between the hydrophobic layer and the diffusion electrode layer.

Thus, Applicants respectfully submit that one of ordinary skill in the art would not be motivated to combine or otherwise modify the AAPA based on teachings of Goldsmith in a manner asserted by the Office Action as it would be extremely difficult, if not unlikely, for such a person skilled in the art to arrive at the membrane electrode structure in which a diffusion electrode is connected to an electrode catalyst layer through a hydrophilic layer.

To establish *prima facie* obviousness, each and every feature of a rejected claim must be taught or at least suggested by the applied art of record. See M.P.E.P. §2143.03.

As explained above, the AAPA and Goldsmith, alone or in any combination thereof, teach or suggest a step or steps wherein a second slurry is applied onto a water repellent layer, wherein the second slurry includes an electron conducting material and an ion conducting material, and then the step of

where the second slurry is then dried to form a hydrophilic layer. Such features, among others, are recited by Claim 1. Therefore, Applicants respectfully submit that Claim 1 is not rendered obvious in view of the AAPA and Goldsmith and should therefore be deemed allowable.

Claims 2-3 and 9-13 depend, directly or indirectly, from Claim 1. It is respectfully submitted that these claims are allowable over the AAPA and Goldsmith at least for the same reasons Claim 1 is allowable, as well as for the additional subject matter recited therein.

Applicants respectfully request withdrawal of the rejection.

Claims 1-3 and 9-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over the AAPA in view of Japanese publication JP 06-44984 (JP '984). Applicants respectfully traverse the rejection.

Claim 1 is discussed above.

The AAPA and deficiencies therein are discussed above.

In JP '984, the electrode catalyst layer is hydrophilic.

In the membrane-electrode structure of the present invention, the electrode catalyst layer is hydrophilic for the transference of protons or the elimination of water generated, and the like.

As indicated in the *Background of the Invention* section of the instant application, when a polymer electrolyte fuel cell including an hydrophilic electrode catalyst layer is produced, sufficient adhesiveness might not be obtained between the electrode catalyst layer and the diffusion electrode.

In order to solve the problem and provide a method for producing a membrane-electrode structure which has an excellent adhesiveness between an electrode catalyst layer and a diffusion electrode, in the present invention, a hydrophilic layer is provided between an electrode catalyst layer and a water-repellent layer.

Therefore, it would have been difficult for a person skilled in the art to anticipate the feature of the present invention and its advantageous effects as stated above.

The production method of the present invention as described above enables the unification of the electrode catalyst layer and the diffusion electrode through the hydrophilic layer, thereby obtaining an excellent adhesiveness between the electrode catalyst layer and the diffusion electrode. Such advantageous effects could not be anticipated in the light of the teachings of APAA alone or in combination with JP '984.

In addition, the AAPA and JP '984 do not disclose a method of laminating a membrane-electrode structure by applying high-viscosity paste. According to the present invention, a second slurry is applied on the water-repellent layer followed by drying, thereby obtaining a hydrophilic layer having an excellent adhesiveness with the water-repellent layer.

To establish *prima facie* obviousness, each and every feature of a rejected claim must be taught or at least suggested by the applied art of record. See M.P.E.P. §2143.03.

As explained above, the AAPA and JP '984, alone or in any combination thereof, teach or suggest a step or steps wherein a second slurry is applied onto a water repellent layer, wherein the second slurry includes an electron conducting material and an ion conducting material, and then the step of where the second slurry is then dried to form a hydrophilic layer. Such features, among others, are recited by Claim 1. Therefore, Applicants respectfully submit that Claim 1 is not rendered obvious in view of the AAPA and JP '984 and should therefore be deemed allowable.

Claims 2-3 and 9-13 depend, directly or indirectly, from Claim 1. It is respectfully submitted that these claims are allowable over the AAPA and JP '984 at least for the same reasons Claim 1 is allowable, as well as for the additional subject matter recited therein.

Applicants respectfully request withdrawal of the rejection.

**Claim Rejection – 35 U.S.C. §102/§103**

Claims 14-16 are rejected under 35 U.S.C. §102(b) as anticipated by or, in the alternative, under 35 U.S.C. §103(a) as obvious over the AAPA, or Landsman, or Heffler, or Goldsmith, or even JP '984. Applicants note that Claims 14-16 are cancelled herein without prejudice or disclaimer, thereby rendering the rejections moot. Applicants respectfully request the rejection be withdrawn.

**Conclusion**

In view of the foregoing, reconsideration of the application, withdrawal of the outstanding objections and rejections, allowance of Claims 1-13 and 17, and the prompt issuance of a Notice of Allowability are respectfully solicited.

Should the Examiner believe anything further is desirable in order to place this application in better condition for allowance, the Examiner is requested to contact the undersigned at the telephone number listed below.

In the event this paper is not considered to be timely filed, Applicants respectfully petition for an appropriate extension of time. Any fees for such an extension, together with any additional fees that may be due with respect to this paper, may be charged to counsel's Deposit Account No. 01-2300, **referencing docket number 101175.00040.**

Respectfully submitted,

  
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Enclosures: Replacement Sheets (2) of Figs. 1(a)-1(f) and 15

MO/elp

**Marked-up Version of Original Abstract**

The present invention provides a method for producing a A membrane-electrode structure having an excellent adhesiveness between an electrode catalyst layer adhered to and a diffusion electrode, and a polymer electrolyte fuel cell using a membrane electrode structure obtained by the production method. Moreover, it also provides an electrical apparatus and a transport machine that use the above polymer electrolyte fuel cell. A wherein the structure is manufactured by applying a catalyst paste onto past comprising a catalyst supported by an electron conducting material and an ion conducting material is applied on a sheet substrate [[2]], and it is then dried, so as to form a plurality of electrode catalyst layers 3, 3. The electrode catalyst layers are thermally transferred onto each side of a polymer electrolyte membrane 1, so as to form a laminated body [[4]]. A first slurry comprising a water repellent material and an electron conducting material is applied on a carbon substrate layer [[6]], and it is dried to form a water-repellent layer [[7]], and then, a second slurry comprising an electron conducting material and an ion conducting material is applied on the water-repellent layer [[7]], and it is dried to form a hydrophilic layer 8, so that to form a diffusion electrode 5 is formed. The previously formed diffusion electrode [[5]] is then laminated on the electrode catalyst layer [[3]] through the hydrophilic layer [[8]], and they are then pressed under heating, so as to integrate the laminated body [[4]] and the diffusion electrode [[5]].

**IN THE DRAWINGS:**

Enclosed herein is a Replacement Sheet of Formal Drawing Figure 1 (f), which is amended to correct the lead lines for reference numerals 7 and 8; and a Replacement Sheet of Formal Drawing Figure 15, which is amended herein to include a -- Related Art -- legend because only that which is old is illustrated.